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(54) **Compound Paper**

(57) A multi-ply wet-formed cellulosic web is formed by depositing a succession of plies on a first forming wire (10), dewatering and removing each ply from the wire before the next ply is formed thereon, and transferring the removed plies successively one on top of the other onto a second forming wire (11) to provide the multi-ply web. At least one ply may be formed by feeding cellulosic stock from a pressure former onto a region of the first forming wire stretched over a convexly curved vacuum dewatering box (Figure 3).

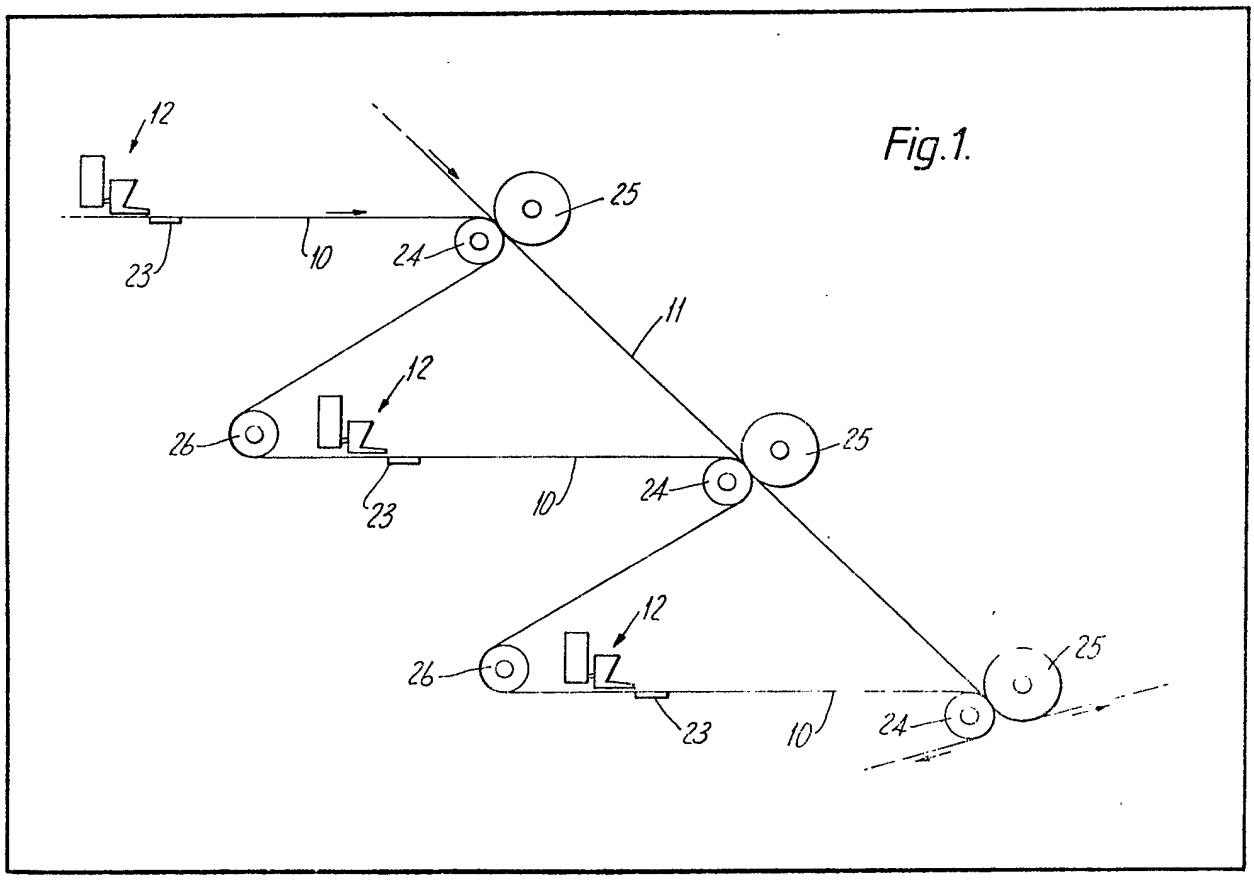

Fig.1.

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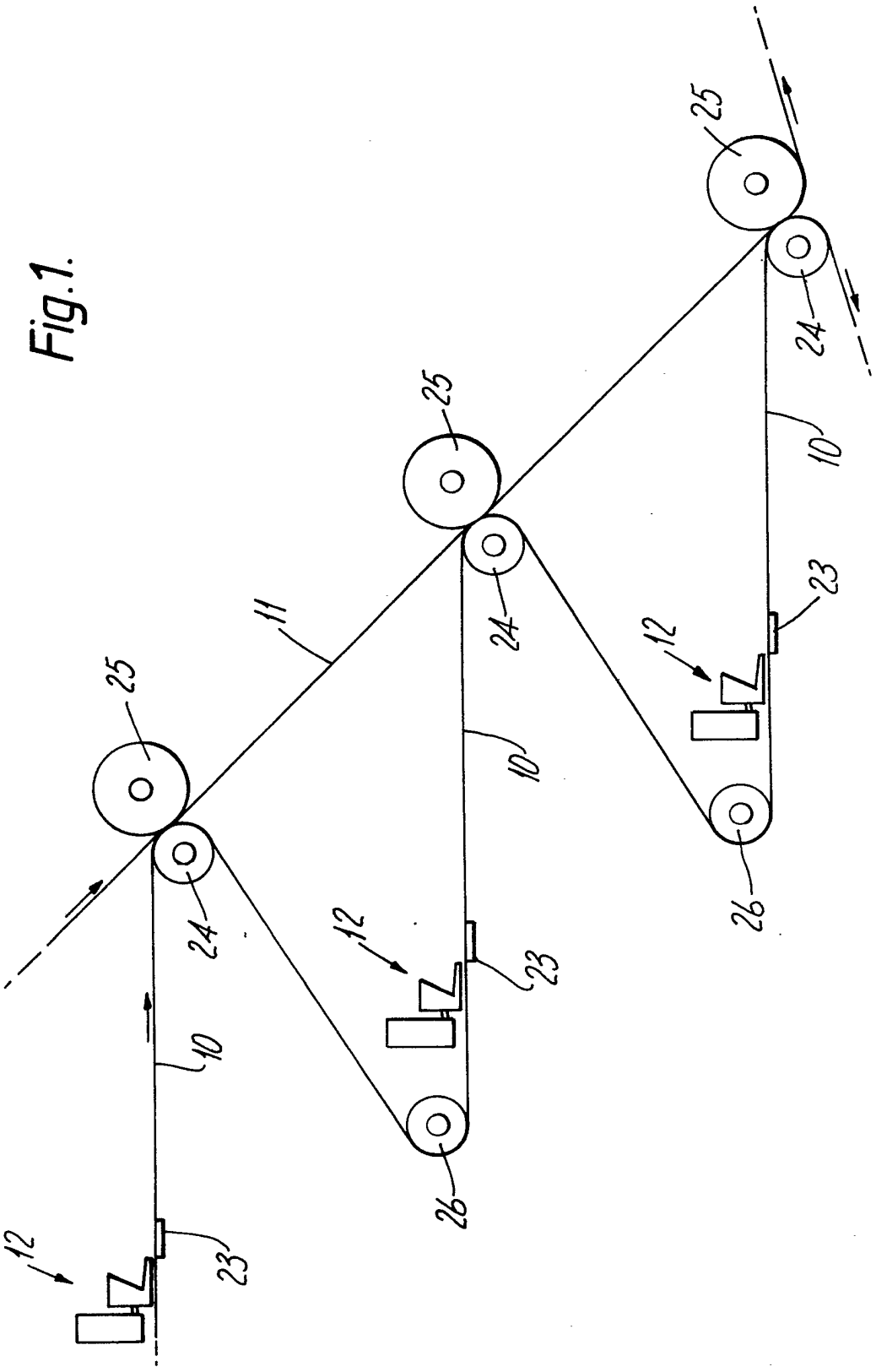
Fig.1.



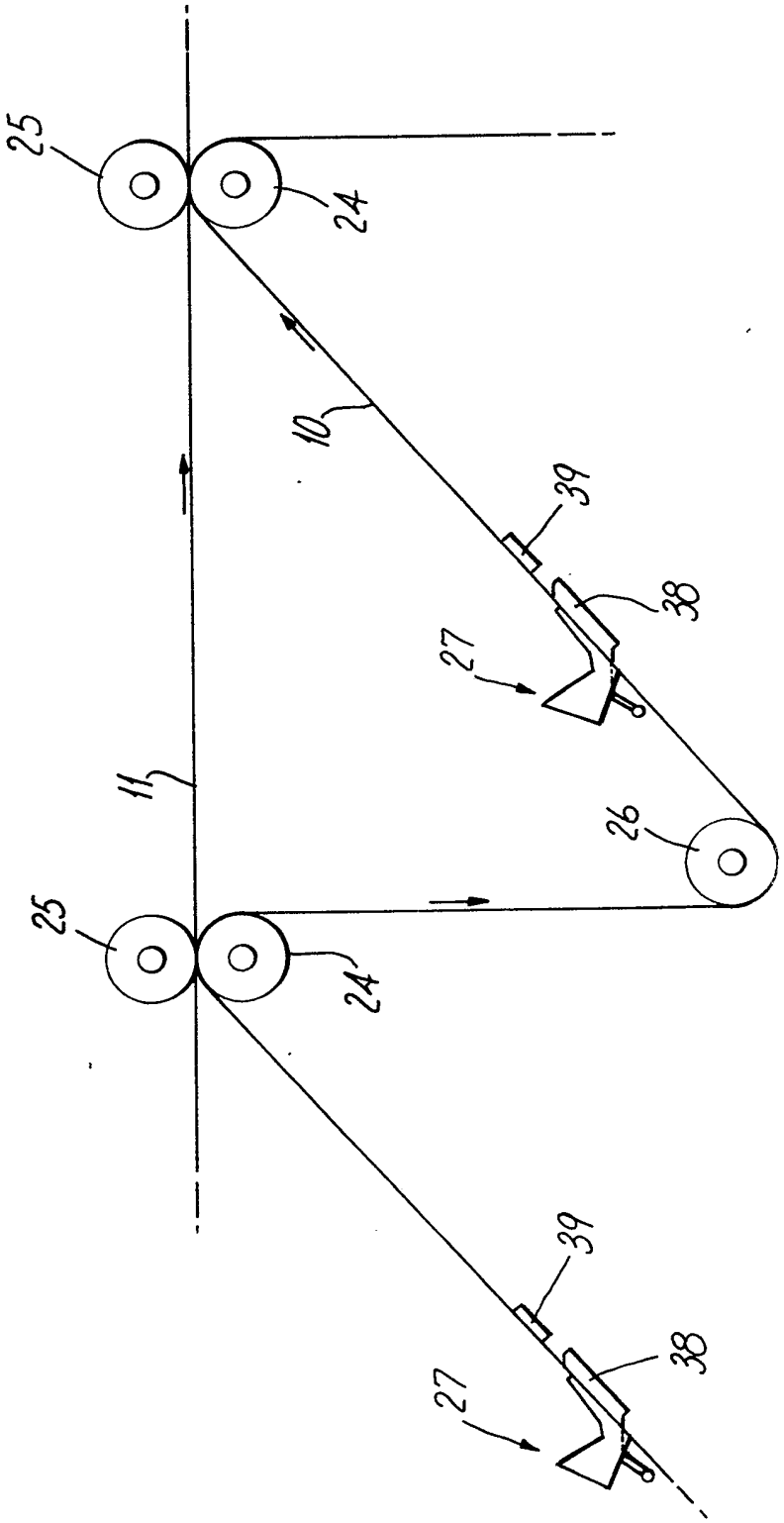


Fig. 2.

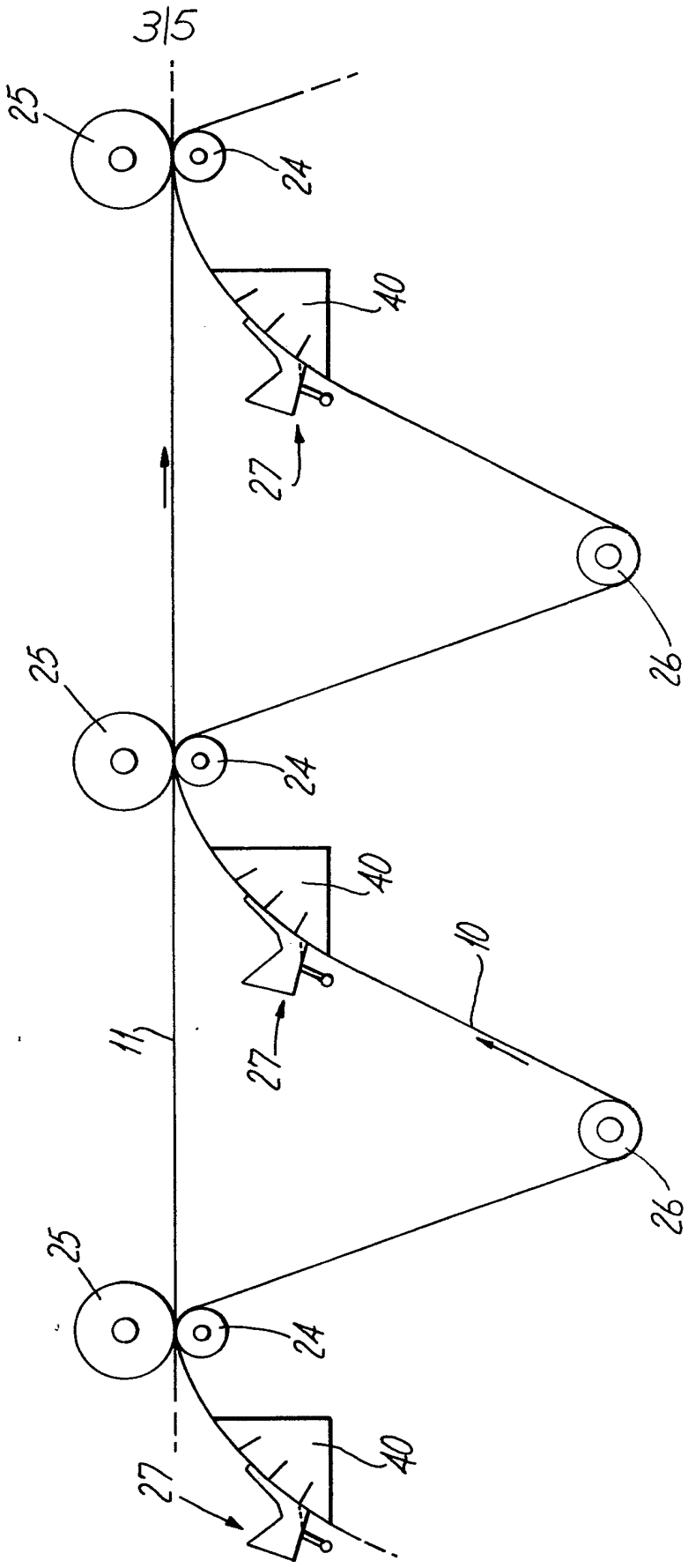


Fig. 3.

Fig.4.

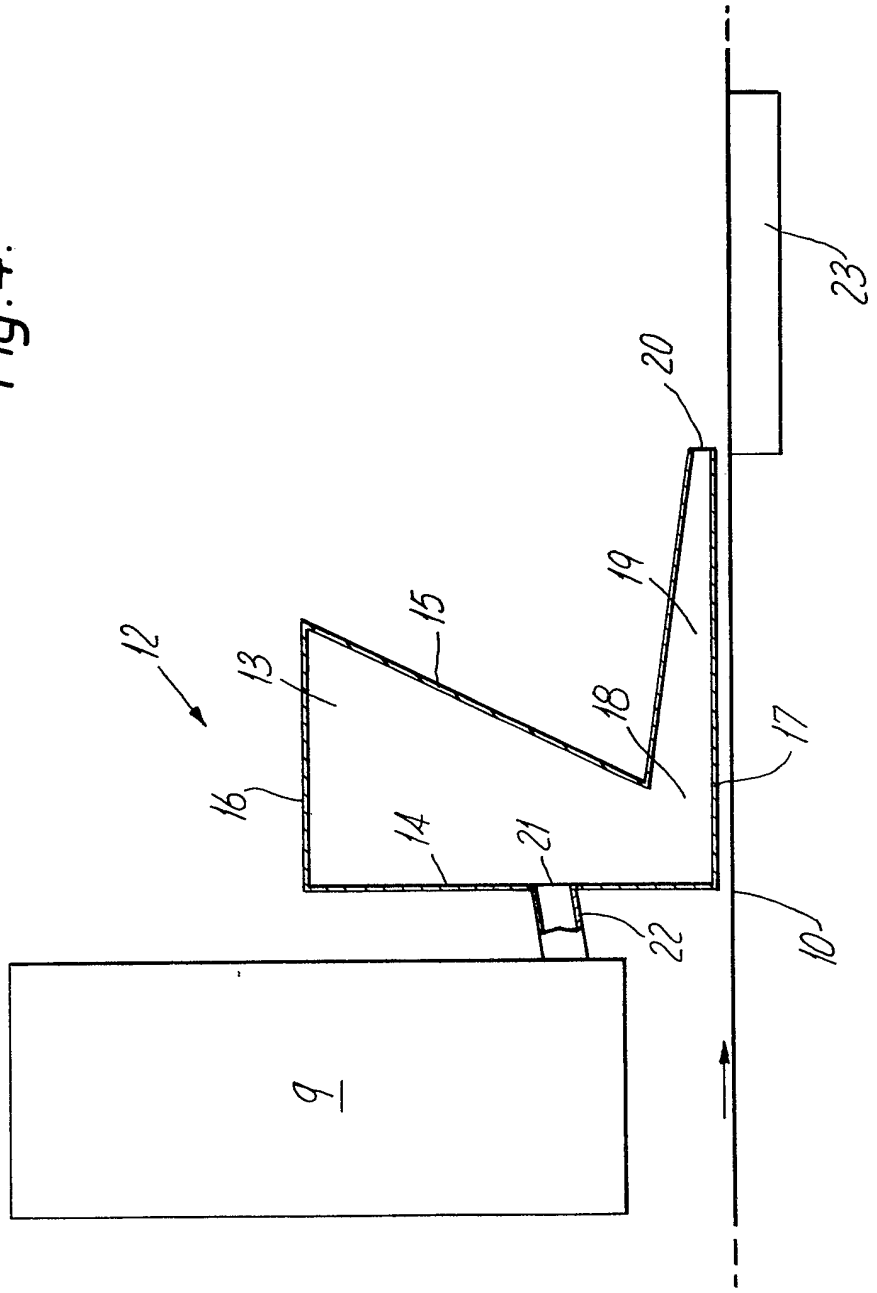
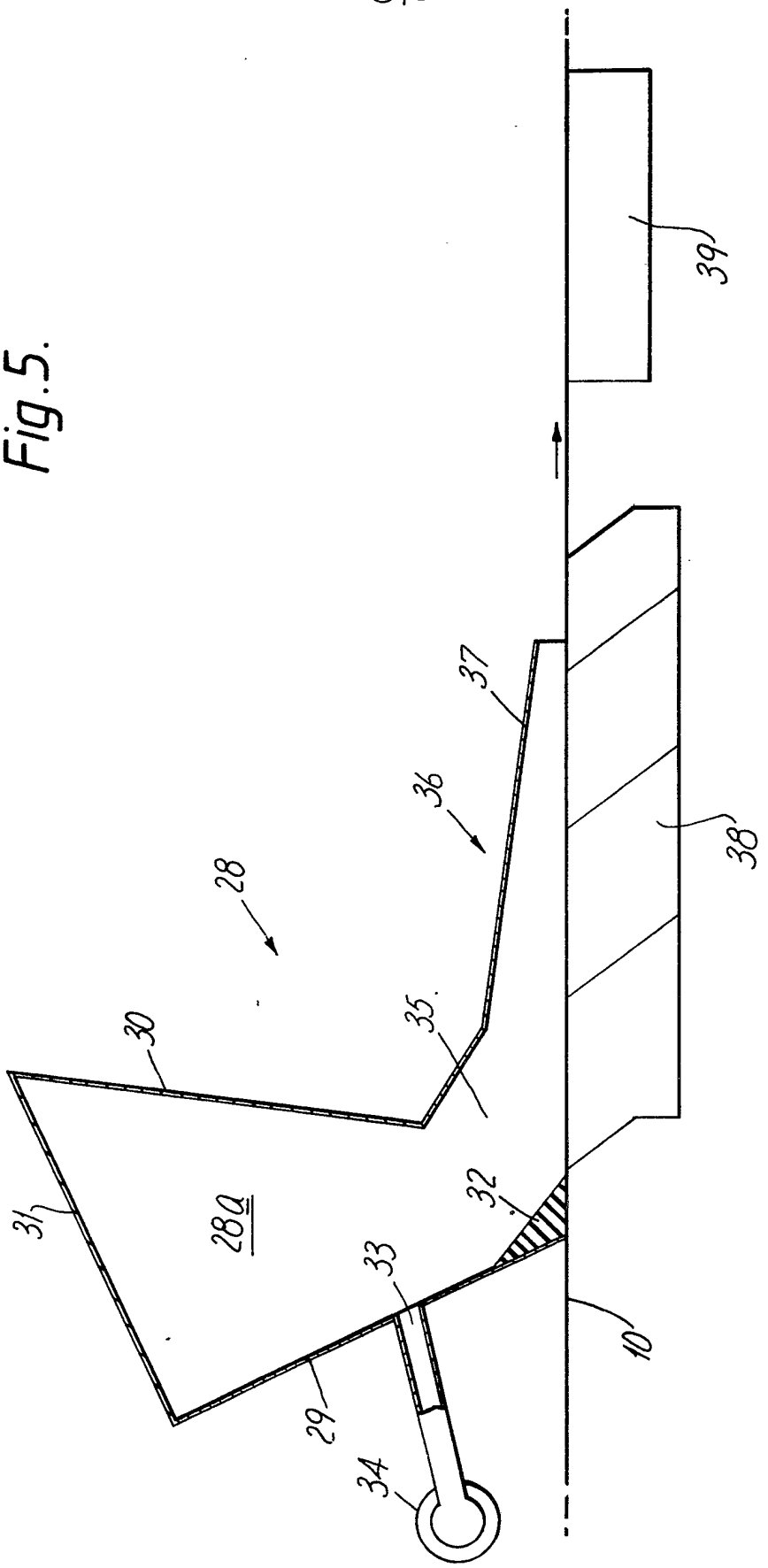


Fig.5.



SPECIFICATION

Method and Apparatus for Making a Multi-Ply Web

This invention relates to a method and apparatus for making a multi-ply web, in particular a multi-ply paper or board web made from wet-formed plies of cellulosic fibrous material. The invention relates to that field of the art wherein plies of wet formed fibrous stock are laid on an endless permeable wire.

Multi-ply paper or board is commonly manufactured by wetlaying successive plies of cellulosic fibrous stock from formers onto an endless permeable wire, dewatering the plies in situ, and subsequently removing the dewatered multi-ply web from the wire. Such a method and apparatus are described in our U.K. patent 975613.

A wet-laid ply may also be prepared by feeding fibrous stock onto the cylinder mould of a cylinder mould fibrous web making machine and subsequently removing the web from the roll. This is described in our U.K. patent 1467479. Plies so made may subsequently be combined to form a multiply cellulosic board or paper.

A disadvantage of wet-laying from successive formers onto an endless wire and subsequently removing the multi-ply web from the wire is that the whole operation takes up a large amount of space. Further, expensive dewatering equipment is required.

Major disadvantages of using cylinder mould machines are that they are bulky and very expensive.

It is an object of the present invention to overcome these disadvantages, thereby to provide a means of manufacturing multi-ply paper or board from cellulosic stock in a reduced space with less expensive equipment and with adequate dewatering.

According to a first aspect of the present invention there is provided a method of making a multi-ply wet-formed web comprising forming a succession of plies on a foraminous first forming surface, dewatering each ply, removing each dewatered ply from the first forming surface before the next ply is formed thereon, and transferring the removed plies successively one on top of the other onto a second forming surface to provide a multiply web

Preferably the removal of each ply from the first forming surface and its transfer onto the second forming surface are performed substantially simultaneously. The transfer may be carried out by bringing the first and second forming surfaces into juxtaposition.

The plies are preferably formed from a stock consisting of cellulosic fibrous material.

A or each ply may be formed by feeding stock from a pressure former onto a region of the first forming wire stretched over a convexedly curved dewatering box.

One or more plies may be formed from a foamed stock.

According to a second aspect of the present invention there is provided apparatus for making a multi-ply wet-formed web, comprising a foraminous first forming surface, a second forming surface, a plurality of ply-forming stations spaced along the first forming surface, means for dewatering each ply between the station where it was formed and the next succeeding station, means for removing each dewatered ply from the first forming surface between said station and said next station, and means for applying the removed plies successively one on top of the other onto the second forming surface to provide a multi-ply web.

Preferably the forming surfaces are endless wires.

At least one of the ply-forming stations may include a flowbox or pressure former for feeding wet stock onto the first forming surface.

When at least one of the ply-forming stations includes a pressure former, the dewatering device associated with that ply-forming station may include a convexedly curved vacuum box over which the first forming wire is stretched.

The means for removing each dewatered ply from the first forming surface and the means for applying each removed ply onto the second forming surface may be provided by opposed rolls nipping together the forming surfaces. One roll may be a honeycomb roll and the other a plain or suction roll.

The vacuum box may be compartmented whereby varying degrees of vacuum may be applied to different areas of the ply being dewatered.

The advantages of the present invention are that, plies are dewatered individually and independently of each other, thereby enabling different furnishes, each with its particular dewatering conditions, to be used for the plies; the apparatus is compact, only two forming wires being used, even when three or more plies are required; bulky and expensive dewatering equipment such as cylinder mould machines are not necessary; and, each ply may be treated individually as required.

The invention will be described merely by way of example with reference to the accompanying drawings in which Figures 1, 2 and 3 are diagrammatic views of three alternative forms of apparatus according to the invention, including ply-forming stations, Figure 4 is detail diagrammatic cross-section of a ply-forming station of Figure 1, and Figure 5 is a detail diagrammatic cross-section of a ply-forming station of Figures 2 and 3.

Referring to Figures 1 and 4, apparatus for forming a multi-ply paper or board comprises a first endless foraminous wire or band 10, a second endless foraminous wire or band 11, and a series of ply-forming stations 12 spaced along the first wire 10.

The foraminous wires 10, 11 are made of phosphor bronze or plastics mesh, or similar materials common in the paper making art.

The ply-forming stations 12 each comprises a flowbox 13 feeding cellulosic fibrous stock from a headbox 9 onto the wire 10. Each flowbox 13 is similar to that described with reference to Figure 1 of our Offenlegungsschrift 2620033 and comprises extending across the width of the wire 10 a closed metal box of quadrilateral cross-section defined by planar walls forming upstream, downstream, top and bottom walls 14, 15, 16, 17 respectively of the flowbox. The upstream and downstream walls 14, 15 converge from the top wall 16 to the bottom walls 17, the angle of convergence being about 25°, and the distance between the top and bottom walls is typically greater than the distance between the upstream and downstream walls at their greatest separation. An outlet 18 is provided in the bottom portion of downstream wall 15 and leads into a shear flow channel 19 having parallel or convergent top and bottom walls ending in a slice 20 through which stock is directed onto the wire 10.

Stock flows from headbox 9 through inlet tubes 22 into the flowbox 13 through apertures 21 in the upstream wall 14 of the flowbox. The apertures 21 are located in the lower portion of wall 14 in such a position that the flow of stock is directed at the downstream wall 15 and does not proceed directly into the channel 19. As described more fully in our co-pending U.K. Patent Application 11122/75 (Serial No. 1519791) entitled "Improvements in or relating to flowboxes", baffles (not herein illustrated) may be provided at the apertures 21 to direct the stock within the flowbox in any desired direction.

A dewatering suction or vacuum box 23 is located under the wire 10 immediately beneath the slice 20. Consequently, well-formed stock applied to the wire 10 is dewatered virtually as soon as it reaches the wire. It will be appreciated that a well-formed web or ply is therefore formed in a very short distance (e.g. 10—20 cm) after leaving the slice. The vacuum box 23 may be compartmentalized in order to apply different degrees of vacuum to different regions of the ply so as to obtain a uniform cross-ply consistency and thickness profile.

After receiving a ply from one ply forming station 12, and before reaching the next ply forming station, the wire 10 together with the ply formed thereon is passed simultaneously with wire 11 through a nip formed by two rolls 24, 25 so that the ply on wire 10 lies between the two wires and is transferred to wire 11 on leaving the nip. This is achieved by passing wire 10 round a portion of the periphery of roll 24 so that the run of wire 10 leaving the nip is at an angle other than 180° to the run of wire 10 entering the nip, whereas wire 11 runs straight through the nip with little deviation.

On leaving the nip, wire 10, which no longer carries a ply, passes round a third roller 26 to the next ply forming station 12 where a new ply is deposited on the wire 10. The new ply is then transferred onto the previous ply on wire 11 by passing wires 10 and 11 through a nip between further rollers 24, 25 in the manner aforesaid.

In this fashion a multi-ply web can be formed on wire 11 by forming each ply separately on wire 10 and transferring it onto wire 11 (or onto a ply already thereon) before the next ply is formed on wire 10. It will be seen that wire 10 travels a zig-zag path whilst wire 11's path is essentially linear in comparison.

Typically, roller 24 is a honeycomb roll and roller 25 is a plain or suction roll. The nip pressures, for cellulosic fibre stock, are typically in the range 0.9—10 kg per linear cm.

Referring now to Figures 2 and 5 there is shown apparatus for forming a multi-ply paper or board similar to that shown in Figure 1, identical features being given the same numbers, and provided with ply-forming stations 27 comprising pressure formers 28. Each pressure former 28 comprises a closed metal box portion 28*a* of quadrilateral cross-section defined by planar walls forming upstream, downstream, top and bottom walls 29, 30, 31, 32 respectively. The upstream and downstream walls 29, 30 converge from the top wall 31 to the bottom wall 32 at an angle of about 25°. A stock inlet 33 from a manifold 34 is provided in upstream wall 29 and directed upwardly at wall 30 as in the flowbox 13 of Figure 4. An outlet 35 is provided in the lower portion of downstream wall 30 and leads into a shearflow channel 36 extending over the wire 10 and comprising an upper wall 37 converging towards the wire 10, side walls (not shown), but no bottom wall. In contrast, therefore, with the channel 19 of Figure 4, the stock is directed onto the wire immediately ~~on~~ leaving the ~~box~~ portion 28*a*.

As described in our above mentioned Offenlegungsschrift 2620033, a high degree of turbulence is generated in the stock within the box portion 28*a*. This turbulence is not lost when the stock reaches the ~~wire~~ immediately under the channel 36.

A ~~dewatering~~ means provided by a vacuum box 38 is provided under the wire 10 immediately beneath the upper wall 37 of the channel 36 to assist the immediate formation of the ply as soon as ~~the stock reaches the wire.~~ A further dewatering box 39 may be provided downstream.

A multiply web is formed on wire 11 of Figure 2 in the same manner as it is formed in Figure 1.

Referring now to Figure 3 there is shown an alternative embodiment of the apparatus of Figure 2 (identical features being given the same numbers and described with reference to Figures 2 and 5) saave that the dewatering means under the wire 10 immediately beneath the upper wall 37 of the channel is provided by a vacuum dewatering box 40 having a surface over which wire 10 passes which is convexedly curved in the direction of motion of wire 10. This provides the equivalent of forming a ply on a cylinder mould by the method and apparatus disclosed in our U.K. patent 1467479, with the advantages that the curved dewatering vacuum box 40 is less

expensive than a cylinder mould machine by a factor of 10, occupies far less space, uses less energy, and is cheaper to maintain. The curved vacuum box 40 may be compartmentalized so as to provide varying degrees of vacuum across the ply as required.

When using cellulosic fibre stock, e.g. for multiply paper or board manufacture, a typical consistency range may be 0.2—2% by weight, depending on the furnish, and the typical basis weight for each ply may lie in the range 8—150 grams per square meter, although figures outside these ranges are not precluded. The apparatus is capable of producing multiply web at the rate of 15—610 m/mm. Typical levels of vacuum in the dewatering boxes lie in the range 5—205 mm Hg.

It is seen that the invention provides a means of manufacturing multiply paper or board from cellulosic stock in a reduced space compared with machinery presently available in the art with less expensive equipment and with adequate dewatering.

It is further possible with the invention to provide multiply sheet in which different plies have different furnishes or formulations, all the plies being initially independently formed on one wire, thus resulting in a great saving of space and machinery. For instance, one or more of the inner plies may be made from foamed stock, or one or more plies may be made from non-cellulosic stock such as synthetic fibre, asbestor or metal fibre.

The apparatus of the invention may be added to existing multiply machines in place of existing formers.

Claims

1. A method of making a multi-ply wet-formed web comprising forming a succession of plies on a foraminous first forming surface, dewatering each ply, removing each dewatered ply from the first forming surface before the next ply is formed thereon, and transferring the removed plies successively one on top of the other onto a second forming surface to provide a multi-ply web.

2. A method as claimed in claim 1 wherein the removal of each ply from the first forming surface and its transfer onto the second forming surface are performed substantially simultaneously.

3. A method as claimed in claim 2 wherein the transfer is carried out by bringing the first and second forming surfaces into juxtaposition.

4. A method as claimed in any preceding claim wherein the plies are formed from a stock consisting of cellulosic fibrous material.

5. A method as claimed in claim 4 wherein a or each ply is formed by feeding stock from a pressure former onto a region of the first forming wire stretched over a convexedly curved dewatering box.

6. A method as claimed in claim 4 wherein one or more plies is formed from a foamed stock.

7. Apparatus for making a multi-ply web-formed web, comprising a foraminous first forming surface, a second forming surface, a plurality of ply-forming stations spaced along the first forming surface, means for dewatering each ply between the station where it was formed and the next succeeding station, means for removing each dewatered ply from the first forming surface between said station and said next station, and means for applying the removed plies successively one on top of the other onto the second forming surface to provide a multi-ply web.

8. Apparatus as claimed in claim 7 wherein the forming surfaces are endless wires.

9. Apparatus as claimed in claim 7 or 8 wherein at least one of the ply-forming stations includes a flowbox for feeding web stock onto the first forming surface.

10. Apparatus as claimed in any one of claims 7—9 wherein at least one of the ply-forming stations includes a pressure former for feeding web stock onto the first forming surface.

11. Apparatus as claimed in claim 10 wherein the dewatering means associated with the pressure former includes a convexedly curved vacuum box over which the first forming wire is stretched.

12. Apparatus as claimed in claim 11 wherein the vacuum box is compartmented whereby varying degrees of vacuum are applicable to different areas of the ply being dewatered.

13. Apparatus as claimed in any one of claims 7—12 wherein the means for removing each dewatered ply from the first forming surface and the means for applying each removed ply onto the second forming surface are provided by opposed rolls nipping together the forming surfaces.

14. Apparatus as claimed in claim 13 wherein one roll is a honeycomb roll and the other roll is a plain or suction roll.

15. A method of making a multi-ply wet-formed web as herein described with reference to Figures 1 and 4, or Figures 2 and 5, or Figures 3 and 5, of the accompanying drawings.

16. Apparatus for making a multi-ply wet-formed web as herein described with reference to Figures 1 and 4, or Figures 2 and 5, or Figures 3 and 5, of the accompanying drawings.

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ST ANNES BOARD MILL CO LTD	N/A

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ABSTRACT:

A multi-ply wet-formed cellulosic web is formed by

depositing a succession of plies on a first forming wire (10), dewatering and removing each ply from the wire before the next ply is formed thereon, and transferring the removed plies successively one on top of the other onto a second forming wire (11) to provide the multi-ply web. At least one ply may be formed by feeding cellulosic stock from a pressure former onto a region of the first forming wire stretched over a convexly curved vacuum dewatering box (Figure 3). □